Origins of the Maturity and Currency Mismatches in the Balance Sheet of Emerging Countries: a Theoretical Approach

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CURRENCY SUBSTITUTION

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Abstract:

The aim of this paper is to highlight the origins of the currency and maturity mismatches in the balance sheets of emerging countries.

We show that short term debt under the form of demandable debt works as a commitment device of the financial intermediary and as a form of protection of foreign lenders in a context of poor enforceability of contracts.

The currency mismatch in the non tradable sector is mainly viewed as a supply-side phenomenon. It results from the choice of foreign lenders whose anticipations of exchange rate risk overpass those of default of the banking and/or private sector following a real adverse shock.

Finally, when it comes to simultaneously explain the maturity and the currency composition of debt, the paper puts into light that the short term foreign currency denominated debt allows investors to offset the debtor default risk in case of depreciation by the option of early withdrawal of the demandable debt.

JEL Classification: F31, F32, F34, G15, G21.

Keywords: maturity mismatch, currency mismatch, real exchange rate, international financial crises.

Introduction

It was long thought that the financial liberalization was undeniably good both for countries adopting it and the world economy as a whole. Higher investment and growth, better saving allocation at international level or better response to external shocks are often brought forward in favour of financial liberalization. Moreover, the international capital mobility was part of the reforms the IMF advocated at the time of the Washington Consensus (1989) for the financial integration of the emergent markets. This strategy attracted large capital inflows in the emerging countries. The rapid process of financial liberalization and financial market deregulation as well as the development of new financial instruments during the 90s set the stage of the capital inflows while fixed exchange rate arrangements gave an illusion of stability to foreign investors.

Nevertheless, starting with the second half of the 1980s, authors like Diaz-Alejandro (1985) have already warned on the risks of financial liberalization in presence of poor regulation. In his seminal paper, he refers to the Chilean crisis of 1981-83 with the aim of illustrating the dangers of the financial reforms in a context of fixed exchange rate regimes, international capital mobility, implicit bailout guarantees and weak regulation and supervision.

The notion of financial liberalization at all costs was called into question when series of capital account reforms were followed by abrupt financial and currency crises.

Among the features of the new breed of crises which took place in the 1990s, the maturity and currency mismatches were seen by scholars of the Asian crisis as the major ingredients of the capital flows instability in emerging countries.

The maturity mismatch was associated to a boom period in international lending in the 1990s. The outstanding stock of debt of emerging-market economies roughly doubled between

1988 and 1997, from $1 trillion to $2 trillion[1] (Rodrik and Velasco (1999)). While medium and long- term debt grew rapidly as well, it was short –term debt that rose particularly rapidly during this period. According to the BIS, prior to the Asian crisis, about 60% of the overall claims of the foreign lenders become due within a year[2].

As for the currency mismatch, this refers to a situation in which some of the domestic debt and all the external debt of the emerging countries was denominated in foreign currencies without hedging of the exchange rate risk. This situation was called "liabilities dollarization" by Calvo (1998).

Nevertheless, in spite of a unanimous agreement on the adverse effects of short term currency denominated debt, the causes of this phenomenon were given little attention. The maturity and currency mismatches are often explained by structural, cyclic or institutional factors on the supply as well as on the demand side of international credit.

However, some questions arise.

What are the incentives of both domestic borrowers and foreign lenders to choose at equiulibrium short term debt denominated in foreign currency as the unique solution on the international credit market?

Why do domestic banks and large firms rely mainly on short term debt in spite of the risks implied by this form of financing?

Why foreign lenders deny all forms of long term lending to emerging markets and prefer short term lending at equilibrium?

In order to deal with such topics it is necessary to imagine the game of lenders and borrowers in the international context. This is an unavoidable stage because the understanding of incentives and constraints of different actors has major consequences in terms of international financial architecture. According to Jeanne (2000), it is difficult to assess the relative merits of these reforms without understanding why mismatches arise in the balance sheet of emerging countries.

The aim of this paper is to highlight the origins of the currency and maturity mismatches in the balance sheets of emerging countries. The first section presents a brief overview of the literature to which this paper is related while the second section draws the general setting of the model and its main hypotheses. The third section focuses on the choice of the debt financial structure in emerging economies that is short term versus long term debt. The next section deals with the choice of its currency composition that is domestic versus foreign currency denominated debt. Finally, in the fifth part, we study the simultaneous choice of maturity and currency composition of the international debt taking into account the previous results as well as the risks incurred by the actors.

[1] The group covers 10 countries in Latin America, 8 in Asia, 8 in Europe, and 11 in the Middle East and North Africa.

[2] The BIS definition is based on the time to maturity, whereas World Bank (Global Development Finance -2000) uses the concept of original maturity of debt. According to the latter criterion, roughly 50% of foreign claims on the emerging countries have the original maturity under a year.

Section 1: Links to the Literature

The maturity mismatch and the endogenous financial structure were first studied in the context of the domestic credit market. (Jensen (1980), Diamond (1984), Bernanke and Gertler (1987), Fama (1988), Jacklin and Bhattacharya (1988), Calomiris and Kahn (1991), Rey and Stiglitz (1994)).These authors showed that banks have a competitive advantage in resource allocation for investment, which entitles them to go against small uninformed depositors. Therefore, demandable debt provides depositors with the option of withdrawing their money any time and becomes part of an incentive scheme intended to discipline the financial intermediary.

The alternative view on the role of demandable debt is that of Bryant (1980), Diamond and Dybvig (1983) and Jacklin (1987). According to them, demand deposits provide flexibility to depositors who are uncertain about their demand for liquidity.

At the international level, short term debt was seen as the optimal outcome for both lenders and borrowers (Jeanne (1998, 2000) and Kashyap (1999)) or as a way of disciplining the bank and preventing it from extracting rents on depositors. (Diamond and Rajan (2000, 2001)).

The currency mismatch was first looked into in the context of the literature on the currency composition of sovereign debt. (Cooper (1971), Calvo (1998), Miskhin (1996, 1999)). Authors like Bohn (1990), Falcetti et Missale (1999) and Jeanne (1999) endogeneized it as a solution to an incentive and commitment problem of the debtor Government. Alternatively, there are few analyses of the private foreign currency debt. Jeanne (1999) shows that foreign currency debt works as a commitment device of the domestic borrowers vis- à- vis their foreign lenders. Furthermore, he argues that foreign currency debt signals that the borrower does not need the cushion provided by domestic currency debt whether a crisis occurs (Jeanne (1999 b)).

Furthermore, Aghion, Bacchetta and Banerjee (2001) developped a third generation model and showed that firms may find it optimal to contract short term debt if the probability of crisis is strictly positive. For Caballero and Krishnamurthy (2000, 2001 b) foreign currency debt implies a situation of underinsurance against systemic shocks.

More recently, the maturity and currency mismatches were seen as the direct consequence of the "original sin" of emerging countries, that is an inability to rise long-term capital, in domestic currency, on the international market (Chamon and Haussman (2002), Eichengreen, Hausmann and Pannizza (2002), Jeanne and Zettelmeyer (2002)).

Section 2: General Setting and Main Hypotheses

Consider a small economy, open to international financial inflows and outflows. This economy lasts for two periods, namely the short term (from t=0 to t=1) and the long term (from t=1 to t=2). The model is typical of an emerging economy and subsequently it focuses mainly on two markets: the domestic credit market and the international one.

The economy is made out of four types of economic actors (the entrepreneurs in the two sectors, the domestic financial intermediary, the foreign lenders and the government which also plays the role of the central bank) and of two sectors, namely:

- The tradable sector composed of firms whose output consists in a single good traded internationally;
- The non tradable sector made of firms which sell their output on the domestic market.

We denote by χ and *(1- χ)* the respective weight of the tradable and the non tradable sector in the economy.

Let us define the real equilibrium exchange rate (ε) as the relative price of tradable to non tradable goods:

$$\varepsilon = \frac{e \cdot p_T^*}{p_N} \qquad (1)$$

where **e** denotes the nominal exchange rate, p_N is the domestic price of non tradable goods and $\boldsymbol{p_T^*}$ denotes the world price of tradable goods. We suppose that the price of tradable goods is exogenous and normalised to unity ($p_T^*=1$). Under fixed exchange rates, the nominal exchange rate is also constant and normalized to unity, that is $e = 1$.

We assume that the firms in the tradable sector are not large enough to affect the interest rates or other prices at international level. Therefore the firms act as price takers in all markets.

The demand for non tradable goods is decreasing with the real exchange rate and prone to shocks. By this hypothesis we introduce in the model the possibility of a real adverse shock.

The Government has a loss function which can be written as follows:

$$L = \xi \cdot (p - \bar{p}) + \Lambda\phi \qquad (2)$$

where

$(p - \bar{p})$ is the gap between the current price and the price at equilibrium of the real exchange rate (that is when $\bar{p}_N = p_T = e \cdot p_T^* = 1$ and $\varepsilon = 1$). The price index *(p)* is computed as the weighted average of price levels in the two sectors of the economy, that is:

$$p = \chi\, e\, p_T^* + (1-\chi)\, p_N \qquad (3)$$

At equilibrium of the real exchange rate, the price index is $\bar{p} = 1$.

Λ is the political cost of the government loss of credibility in case of abandon of fixed exchange rates.

ϕ is a dummy which takes two values, namely $\phi = \{0, 1\}$ where

$\phi = 1$ means that fixed parity is abandoned which furthermore implies an additional cost to the Government (Λ, the political cost previous defined) and

$\phi = 0$ implies that there is no regime switch and no additional cost to the Government loss function.

ξ is the coefficient reflecting the importance of the inflation in the Government loss function.

Tradable producing firms have direct free access to the international credit market whereas non tradable producing firms depend on the domestic banks to finance their investment projects (cf. Schneider and Tornell (1999)[3]).

Foreign lenders are risk neutral and their placements in the emerging economy may take the form of short term debt (demandable debt or credit lines with rollover), long term debt or equity investment in banks and domestic firms.

[3] Schneider and Tornell (1999) revealed the asymmetric performance and the asymmetric financing of the tradable and non tradable sectors. According to these authors, the non tradable sector experienced a more rapid growth during the boom period but it was the hardest hit by the crisis and recovered more slowly in the aftermath of the crisis. Furthermore, most part of the credits was directed to the non tradable sector and therefore banking sector difficulties often originated in the non tradable sector financing.

The entrepreneur of the non tradable sector is required to pay off a positive amount $\boldsymbol{C > 1}$ at date **t** which varies according to the underlying risks. Let us denote the revenues for different combinations of maturity and currency by $\tilde{r}_{1D}, \tilde{r}_{1D^*}, \tilde{r}_{2D}, \tilde{r}_{2D^*}$.

It is worth noticing that the domestic bank has a central position as go between foreign lenders and non tradable producing firms because of its monopoly power over the intermediation relationship.

The non tradable sector entrepreneur participates only with his specific skills to the project. The investment requires, apart from human capital, a specific non tradable input (real estate, for instance) and is financed by the domestic bank.

The project of the domestic firm requires one unit of non tradable good at date t=0. The investment project may turn out to be "early" (yielding an amount of R at t=1) or "late" (illiquid at date t=1 and yielding R at t=2). Initially, the project "type" isn't known by either lenders or borrowers and it is revealed in t=1 only to the latter. Let α be the probability, in t = 0, that the project wil be "late".

The probability distribution of project cash flows may be written as follows:

t=0	t=1	t=2	
Initial expenditure	cash flows 1	cash flows 2	
-1	$\begin{cases} 0 \ , \\ C \ , \end{cases}$	$\begin{cases} C \ , \ with\ the\ probability\ \alpha \\ 0 \ , \ with\ the\ probability (1-\alpha) \end{cases}$	*(4)*

and we assume that the cash flows of early projects at t = 1 can not cover the initial expenditure, that is ($C(1-\alpha)<1$).

The contract between the bank and the non tradable sector firm is akin to a standard debt contract stipulating that the debtor undertakes to pay off a strictly positive amount C at date t (t = 1, 2). Should the opposite occur the bank takes possession of the firm and is free to liquidate the investment project. Let us denote by $r < 1$ the liquidation value in t = 1 of a project requiring one unit of initial expense.

The bank is free to replace the initial entrepreneur by another one who possesses the same technical skills. The schedule of repayments is unchanged; nevertheless, as the original entrepreneur was particularly suited for the strategy, the project new cash flows will be smaller, of only γC, with $0 < \gamma < 1$ (for a gross return of C in presence of the original entrepreneur).

A last hypothesis deals with the private contracts enforcement. The regulation is weak, there is no investors' protection and contracts may be renegotiated midway[4] (enforceability problems). Therefore contracts lack temporal coherence in the sense that debtors may be led to reconsider the terms of the contract at an intermediary stage. Contracts are thus characterized by a soft budgetary constraint due to the weak regulation and inefficient bankruptcy laws.

In the next section we focus on the optimal structure of banks and tradable producing-firms.

[4] The bank can, for example, announce incomes lower than those effectively earned.

Section 3: The Choice of the Financial Structure (Short Term versus Long Term)

In this section the currency in which international debt is denominated is left aside. Since the choice of the financial structure is similar in the two sectors of the economy, we disregard whether debtors are from the tradable or from the non tradable sector. In the tradable sector, the equivalent for demand deposits of the non tradable sector is the rollover on the interbank market. Actually, tradable sector producing firms borrow from foreign banks on the international financial market. Therefore we study the relationship between the firm, the domestic bank and the foreign lenders, in order to highlight the optimal financial structure of domestic borrowers.

3.1. The Bargaining of the Bank and the Domestic Firm

Since the domestic entrepreneur has not an initial endowment, his participation to the investment project consists solely in his personal skills. At date t=0 his investment opportunity requires a quantity of one non tradable good and he addresses the domestic bank in order to get a credit. The amount and the schedule of project cash-flows are given by the relation *(4)*. At the time of the conclusion of the contract neither part knows the "type" of the project that may be a premature, liquid project at t =1 or a late one, illiquid in the short run and yielding R at the end of two periods. This information will be revealed only in t = 1 and will be known only by the entrepreneur.

Under the soft budgetary constraint the repayment that the borrower is required to make to the bank is fixed trough bargaining between the entrepreneur and the financial intermediary. At any time of their relationship, the borrower may attempt to renegotiate the initial terms of the contract using the threat of leaving the project. By doing so, he knows that the bank will lose, even if it replaces him by another entrepreneur. According to our previous assumptions, the bank gets only γC *(with* $0 < \gamma < 1$) by replacing the initial entrepreneur. Therefore, at project maturity, the entrepreneur makes a repayment of exactly γC *to* the bank which accepts it because it could not have better if it replaces him.

The state contingent contract (through the transfer of control rights to the bank in case of default) is like an option of equity investment bought by the bank on the firm's capital. It helps somehow to solve the information asymmetry between the concluding parties. The domestic bank has a monopoly on the initial entrepreneur and no other bank could do the same. Therefore, the bank has specific skills in collecting resources which give her bargaining power in the relationship with the domestic borrower as well as with the foreign lenders, on the international financial market.

Result 1: The firm's retained earnings on the project are equal to the opportunity cost of its replacement by the bank. Therefore, the bank's return is $R \equiv (1-\gamma)C$, *with* $0 < \gamma < 1$.

3.2. The Bargaining of the Domestic Bank and the Foreign Lenders

The contract between domestic bank and foreign lenders may take the following forms:

- Simple non liquidating contract, equivalent to a long term debt contract (due in t=2)

according to which the borrower cannot withdraw his money at an intermediary stage without incurring penalties. Should bank liquidation occur, such (senior) claimants are reimbursed after demandable depositors are paid off.

- Simple liquidating contract equivalent to standard demandable-debt contract, according to which the creditor receives the due payment at any moment of their relationship. In case of bank run, demand depositors are paid according to their position in the line.
- Equity investment contract in the bank capital, which allows for a proportion of the project total return at maturity. In case of liquidation, such a claimant is paid after bank customers and short term claimants.

In what follows we do not distinguish between long term debt and equity investment since in the context of a two-period model they both represent long term obligations. Instead, we focus on the choice of short term debt versus long term debt in the financial structure of the domestic bank and the tradable producing- firm.

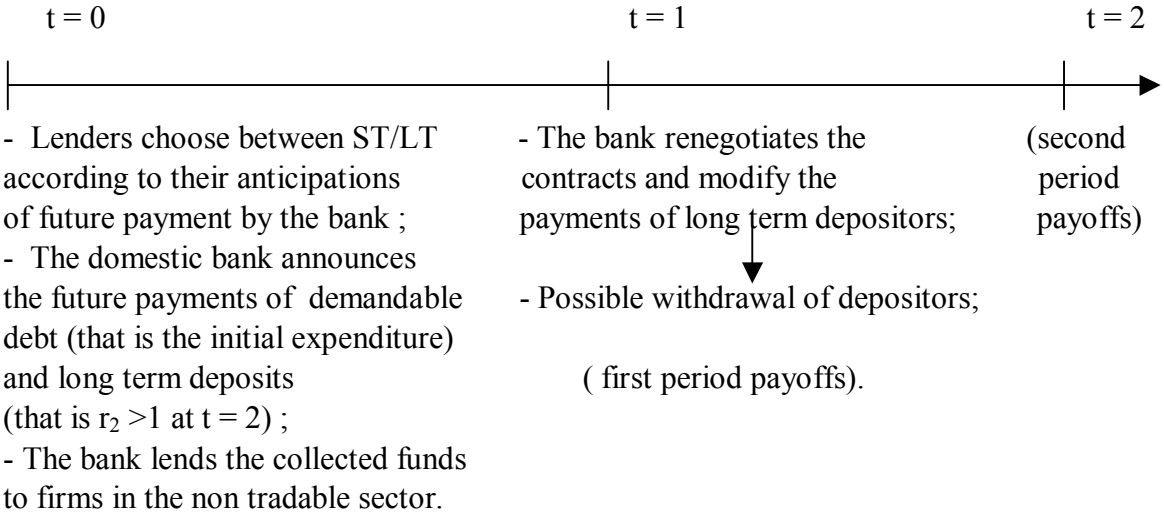
The financial intermediary has acquired specific collecting skills along its relationships with domestic entrepreneurs. In the same way a particular entrepreneur could threaten to withdraw his human capital, the bank can renegotiate, at an intermediate stage (at t =1) the contract concluded with its foreign lenders. In a context of poor enforceability of contracts, the bank may especially announce, at t=1, future payments at the end of the second period inferior to those initially promised to the lenders.

As for the representative lender, we suppose that his potential withdrawal is motivated solely by the expectation of poor performance of the domestic bank and not by liquidity needs at an intermediary stage.

The players taking part in the dynamic game are:

- the foreign lenders, who have two strategies available at t = 0 namely {short term lending; long term lending} and {withdraw; not withdraw} at t = 1;
- the domestic bank which has two strategies available at t = 1, namely {renegotiate debt contracts; respect debt contracts}.

The order of decisions can be represented as follows:



Let us reason by backward induction. Foreign lenders play last, at t = 1, by choosing to withdraw or to keep the invested funds until t =2, according to the bank expected behaviour and their future payment at the end of the second period. First, consider the long term debt. Should depositors withdraw at an intermediary stage, they undergo a loss connected to the late projects

liquidation. Suppose that their payoff is r < 1 in the case of early withdrawal compared with $r_2 > 1$ which represents their payoff at the end of two periods.

Suppose that the bank attempts to modify, at t = 1, the amount of cash flow rights, their schedule or to take any other action against the foreign lenders' interests.

Whenever lenders have long term claims on the domestic bank, in case of liquidation, they can seize the bank assets but they become in turn responsible for the repayment of "junior" claims (demandable debt, for instance). Investors miss specific collection skills and the bank knows that, in its absence, their returns would go to zero. Therefore, the bank will propose payoffs lower that those previously announced at t = 0 and that means an additional profit (denoted by **μ**) of the bank on the revenues of foreign lenders.

Conversely, let us analyse the case for the demand deposits. Lenders can withdraw their funds at any moment (at t = 1 or t = 2) without penalty. Whenever the bank decides to renegotiate the contracts and modify second period payments, lenders may trigger an efficient bank run[5] at t = 1 leading to the liquidation of late projects and future production losses.

The bank decides to renegotiate, at t = 1, the ongoing contracts according to the type of contract chosen by depositors. The amount paid off to depositors at the end of the second period must be at least equal to that obtained in case of early withdrawal at t= 1 so that depositors keep the funds with the bank following renegotiation. Precisely, in the case of demandable debt, the bank is constrained by early withdrawal to pay out at the end of the second period the amount announced in the beginning (that is $\mu^* = 0$). Conversely, the new payoffs of long term depositors (that is $R(1-\mu)$, where μ represents the additional bank profit at the end of two periods) may go down to the liquidation value ($r < 1$) in case of early withdrawal at an intermediary stage:

$$r_2 (1-\mu^*) \geq r \qquad (5)$$

where we assumed a discount rate equal to unity.

The maximal rent extracted by the bank on the depositors' revenues can thus be written:

$$\mu^* = 1 - r_2 / R, \qquad (6)$$

where $0 < \mu < 1$.

Initially (at t = 0), the representative lender chooses his deposit maturity according to the expected behaviour of the domestic bank at t = 1. As we have just seen above, whenever he chooses demandable debt, the bank commits itself not to alter the second period revenues. Therefore, the depositor decides to keep his funds with the bank till the end of the second period. Alternatively, whenever the depositor lends long term, the bank cannot commit not to renegotiate the contract to its profit. According to the relation *(6)* here above, the depositor's payoff is $r < 1$ whenever he withdraws at t= 1 or wait for two periods.

Demandable debt is thus strictly preferred by foreign lenders as it solves the conflict of interests between bank and depositors in presence of uncertainty on the bank future performance. The right of demand depositors to withdraw at any period the funds previously invested whenever they have doubts on their long term repayment implicitly transform them into

[5] Such bank run driven by the fear of poor performance anticipated by the informed depositors is often referred to as fundamental bank run (see Gorton (1985) and Chari and Jagannathan (1988)) unlike "speculative" bank runs (Bryant (1980), Diamond& Dybvig (1983)).

monitors of the bank. Under these circumstances, the bank can commit itself to pass onto depositors whatever it collects from the entrepreneurs without renegotiate the contracts.

Therefore, short term debt enables the bank to ex-ante commit to a set of payoffs that it would not be able to provide to depositors having ordinary debt. Demandable debt becomes thus a discipline device of the financial intermediary and a form of protection of foreign lenders in a context of poor enforceability of contracts.

Let us compute the fraction of late projects that the bank have to liquidate at t = 1 in order to pay out the early withdrawal of short term lenders. In the light of the *Result 1*, bank's revenues from the investment projects can be written as follows:

t=0	t=1	t=2	
-1	$\begin{cases} 0 \ , \\ R \ , \end{cases}$	$\begin{cases} R \ , \ with\ probability\ \alpha \\ 0 \ , \ with\ probability\ (1-\alpha) \end{cases}$	*(7)*

where β, the percentage of late projects liquidated at an intermediary stage, is given by the following equation:

$$1 = (1-\alpha)R + \beta\alpha r \rightarrow \beta = 1\frac{(1-\alpha)R}{\alpha \cdot r} - \qquad (8)$$

where $0 < \beta < 1$.

<u>Result 2</u>*: The optimal form of financing for both lenders and borrowers in a context of poor enforceability of contracts is the demandable debt.*

The previous analysis brings out the fact that short term debt is the equilibrium solution of the game between lenders and borrowers in a context of poor enforceability of contracts. The nature of the sequential service (according to which depositors are repaid on a "first come, first served" basis) creates a collective action which forces the domestic borrower to fully respect its obligations.

By taking on demandable debt, the domestic bank commits itself not to expropriate the foreign lenders and therefore signals the good quality of its projects. As for the foreign lenders, they know that domestic borrowers, who finance themselves by short term debt, are exposed to the risk of early liquidation of their projects in case of bank run. Therefore, the risk premium required by the foreign investors on their short term lending to emerging countries was particularly low ex ante. But, at the same time, the term structure of interest rates depends also on the risk associated to different debt maturities. This implies that borrowers who take on excessively short term debt become more vulnerable to liquidity crises. Therefore, short term debt proves to be riskier and more expensive ex post, in case of a run by foreign investors. Uncertainty on the quality of the bank assets may trigger a bank run on the depositors' side. Therefore such panic keeps the bank out of the intermediation relationship and therefore induces an ever more marked decline in the assets value.

Along the 1990s, there were also some market imperfections as well as factors connected to the international context which encouraged short term lending to emerging countries. We can generally distinguish aggravating factors on the demand side (for instance the rapid financial deregulation giving domestic borrowers easy access to international capital markets; financial liberalisation in emerging markets not accompanied by adequate regulation and prudential

supervision; the taxation of international flows favourable to short term capital movements) as well on the supply side (the growth of broad money in industrial countries[6], the decline in short term interest rates, the presence of implicit or explicit government guarantees which created moral hazard; BRI[7] rules concerning international credit).

In our vision, the maturity mismatch in balance sheets of emerging markets is a supply-induced phenomenon mainly due to the weak regulatory environment of the emerging countries prior to crises.

Short term debt represented the unique solution for foreign investors who were not protected by domestic regulations. It could be viewed as a form of "self-protection" (although imperfect) of foreign lenders in order to offset the insufficiency of the regulatory framework in emerging countries.

Section 4: The Choice of the Currency Composition of Debt (Foreign versus Domestic Currency)

In this section we focus on the currency mismatch in balance sheet of emerging countries. We aim at explaining why banks and large firms in emerging markets took on large currency denominated debt whereas, on the assets aside, these funds financed domestic investment projects. Like the short term borrowing, foreign currency denominated debt is less costly ex ante but generally proves to be riskier and more expensive ex post. The borrowers are exposed to the exchange risk whether their revenues are in domestic currency. Furthermore, even though it is not a direct consequence, the currency mismatch implicitly holds a significant credit risk whenever banks' credit to domestic firms is also denominate in foreign currency. Unless they are net exporters, in case of depreciation, the bank undergoes an exchange rate risk as well as a credit risk and therefore it will be unable to pay off its debts to foreign lenders.

As the foreign debt of the tradable producing firms doesn't imply a currency mismatch, we focus on the non tradable sector financing. It is worth noticing that, unlike the tradable sector financing, the foreign currency denominated debt of domestic banks is not justified by the anticipation of a currency crisis and the subsequent devaluation of the domestic currency. Indeed, the depreciation has a strong adverse effect on the domestic currency valuation of bank debt denominated in foreign currency. Therefore, banks would be unable to meet their obligations whose value increases in domestic terms.

4.1. The currency composition of the non tradable sector debt

It is worth noticing that unlike the tradable sector financing, it is not the perspective of a balance of payment crisis and the underlying devaluation which encouraged foreign currency

6 The annual rate of progression of wide aggregates in industrial countries (United States, Japan, United Kingdom and Euro Zone) which had fallen to 2,5 % at the end of 1994 exceeded 6 % at the beginning of 1996, whereas short-term interest rates lost 1 % over the same period (68-th Annual report of the BRI,1998).

7 Minimum capital adequacy ratio is established at 20 % in the case of short-term loans to non OECD countries compared with 100% of credits with a maturity superior to the year.

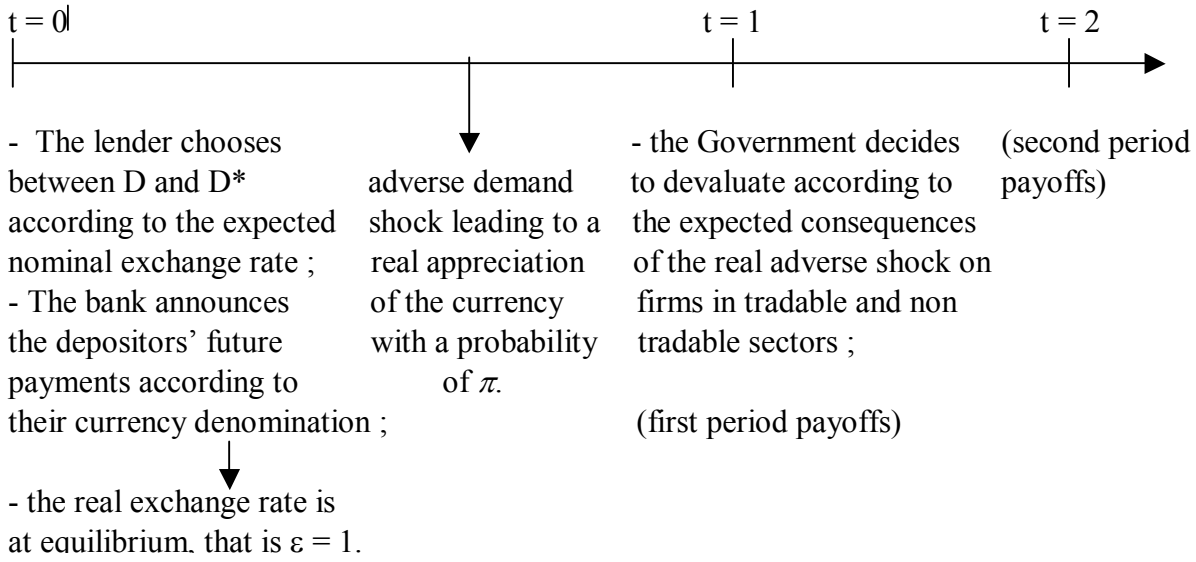
denominated debt of domestic banks. In such a case, the latter would be unable to pay off their foreign debt as its value, in domestic terms, would be superior to that under fixed exchange rates.

Let us identify the risks associate with each type of loan. The results are summarized in table 1 below:

Foreign Lender deposits with the domestic bank		Domestic bank lending to the non tradable sector firm	
Domestic currency denominated debt (D)	Foreign currency denominated debt (D*)	Domestic currency denominated debt (D)	Foreign currency denominated debt (D*)
Exchange rate risk in case of nominal devaluation ($\tilde{e}$).	Bank default risk in case of nominal devaluation ($\tilde{\phi}$) ; No exchange rate risk. *(maturity mismatch)*	Neither exchange rate risk nor default risk induced by the nominal exchange rate variation.	Default risk of the domestic firm in case of nominal devaluation ; No exchange rate risk. *(maturity mismatch)*

Table 1

In the present section we do not take into account the maturity of the foreign lending to the emerging country. The Government intervention in the economy is made through the nominal exchange rate following a trade-off between the abandon and the defence of fixed parity.
The order of decisions is illustrated below:



Consider the realisation, during the first period, of an exogenous adverse shock affecting the terms of trade. Accordingly, the demand of non tradable goods rises, leading to an increase in their price and to a real appreciation of the currency (relation *(1)*). Under a fixed exchange rate regime (*e = 1*), since $p_T^*=1$, the shock on the terms of trade shows through the price level of non tradable goods ($\tilde{p}_N$). Furthermore, assume that $\tilde{p}_N$ is a continuos random variable following an uniform distribution on [1, a], where *a* denotes the upper bound of the price of non tradable goods.

The Government makes a trade-off between the costs of maintaining the fixed exchange rate and those of abandoning it. The adoption of a flexible arrangement following the adverse real shock allows for the equilibrium of the real exchange rate and preserves the external competitiveness of the economy. Conversely, according to the relation *(3)*, inflation rises and, in addition to that, the Central Bank has to bear a political cost of abandoning the peg which is a cost of credibility loss on the financial market.

The Government overlooks the repercussions of a nominal devaluation on the stability of the domestic banking sector. His decision motivated by the protection of the private sector affects the overall financing capacity of the banking sector and therefore the production level of the private sector (balance sheet effects).

More precisely, the Government decides to abandon fixed exchange rate (and to undergo nominal depreciation) following an adverse real shock when the loss under fixed rates is equal to the loss under flexible exchange rates. Let us write the loss function in these two distinct cases as a function of the price of non tradable goods. ($p_N = \frac{1}{\varepsilon}$).

Under fixed exchange rates, the government loss function can be written as follows:

$$L_1 = \xi \cdot (p - \bar{p}) \qquad (9)$$

where

$$\bar{p} = 1 \text{ and } p = \chi\, e\, p_T^* + (1-\chi)\, p_N \qquad (4)$$

The previous relation thus becomes:

$$L_1 = \xi \cdot (p - \bar{p}) = \xi \cdot (p - 1) = \xi \cdot \left(\chi + (1-\chi) \cdot p_N - 1\right) = \xi \cdot (1-\chi) \cdot (p_N - 1) \qquad (10)$$

Under flexible exchange rates, the nominal exchange rate *(e)* offsets the real appreciation of the currency, which implies $e = p_N$ so that $\varepsilon = 1$. Let us write the government loss function taking into account the political cost of credibility:

$$L_2 = \xi \cdot (p - \bar{p}) + \Lambda \qquad (11)$$

where $\bar{p} = 1$ and $p = \chi\, e\, p_T^* + (1-\chi)\, p_N = \chi\, p_N + (1-\chi)\, p_N = 1$

which finally enables us to write:

$$L_2 = \Lambda \qquad (12)$$

To sum up, the government abandons the peg, following the adverse shock, whenever the price of non tradable goods is above a threshold, denoted by p_N^*, where:

$$p_N^* = 1 + \frac{\Lambda}{\xi \cdot (1-\chi)} > 1 \qquad (13)$$

which implies the following condition for the exchange rate:

$$\varepsilon < \varepsilon^* = \frac{\xi \cdot (1-\chi)}{\xi \cdot (1-\chi) + \Lambda} < 1 \qquad (14)$$

Let us analyse these two cases:

- *A real adverse shock occurs (at time (t), for instance)and the Government decides to abandon the fixed exchange rates.*

Under flexible regimes, the nominal exchange rate depreciates and the nominal depreciation is equal to the increase in prices of the non tradable goods under fixed rates (that is the inverse of the real depreciation). Under these circumstances, on the one hand, banks have to raise more resources, in domestic terms, in order to pay out its creditors. On the other hand, the real sector

is not affected by the nominal depreciation of the domestic currency and the price of non tradable goods remains at its level before depreciation.

- *A real adverse shock occurs and the Government decides to defend fixed exchange rates.* The decline in the price of tradable goods in terms of non tradable goods leads to competitiveness losses in foreign trade and thus affects the revenues of exporting firms (of the tradable sector).

We look for the Nash equilibrium of the dynamic game involving the following players:

- the foreign lenders, who have two strategies available at t = 0 namely {foreign currency denominated loan; domestic currency denominated loan};
- the domestic bank which announces, at t = 0, the depositors' future payments according to their maturity;
- the Government which has two strategies available at t = 1, following the adverse shock on the terms of trade, namely {devaluate the nominal exchange rate; defend the peg};
- the Nature, playing during the first period. As a consequence, the price of non tradable goods is beyond the equilibrium level (*1*) with a probability of π, which requires a nominal devaluation in order to re establish the equilibrium of the real exchange rate.

Let us reason by backward induction. The government plays last and decides to devaluate the nominal exchange rate whenever the price of non tradable goods is above p_N*. We denote by ψ the probability of a nominal devaluation of the domestic currency, in the aftermath of the adverse shock, where $\psi = P\,(e > 1 / p_N > 1)$.

Furthermore, we can identify two cases, namely:

▪ $\tilde{p}_N = p_N > p_N^* > 1 \rightarrow$ the government takes the decision to devaluate the nominal exchange rate (with a probability of ψ) ;

▪ $\tilde{p}_N = p_N$, where $1 < p_N < p_N^*$ the government defends the peg following the adverse shock (with a probability of $1-\psi$).

The probability of a nominal devaluation can be computed as follows:

$$\psi = P\,(\tilde{p}_N > p_N^*) = P\left(\tilde{p}_N > 1 + \frac{\Lambda}{\xi \cdot (1-\chi)}\right) = 1 - P\left(\tilde{p}_N < 1 + \frac{\Lambda}{\xi \cdot (1-\chi)}\right) \qquad (15)$$

$$\psi = 1 - F\left(1 + \frac{\Lambda}{\xi \cdot (1-\chi)}\right) \qquad (16)$$

Since the random variable $\tilde{p}_N$ follows a uniform probability distribution on [1, a][8], its repartition function can thus be written as $F(x) = \frac{x-1}{a-1}$ for $x \in [1, a]$ and the previous relation thus become:

$$\psi \,^{9} = 1 - \frac{\Lambda}{\xi \cdot (1-\chi) \cdot (a-1)} \qquad (17)$$

[8] This hypothesis implies that p_N may take any value on [1, a] with the same chance of realisation.

[9] <u>*Example*</u> : Suppose that a = 3 (that is the upper bound of non tradable goods) , ξ = 0,7 (that is the coefficient of inflation in the government loss function), χ = 0,5 (the weight of the tradable sector in the economy) and Λ = 0,55 (that is the credibility cost borne by the government in case of nominal devaluation). The probability of nominal devaluation following an adverse shock on the terms of trade

provided the necessary condition:

$$\Lambda < \xi(1-\chi)(1-a) \qquad (18)$$

In turn, the foreign lenders choose the currency composition of their lending according to their anticipations of nominal devaluation of the domestic currency. The expected payoffs of depositors are given in the table 2 below:

$\pi = P(\tilde{p}_N > 1)$ real appreciation		Foreign lenders	
		D* (foreign currency loan)	D (domestic currency loan)
Government	Nominal devaluation (with probability ψ)	Nominal exchange rate risk $\tilde{r}_D = r_D / E(\tilde{e})$	Default risk of the domestic bank $\tilde{r}_{D^*} = r_{D^*}\left(1 - E(\phi_b(\tilde{e}))\right)$
	Defence of the peg (with probability $(1-\psi)$)	$\tilde{r}_D = r_D$	$\tilde{r}_{D^*} = r_{D^*}$
$1 - \pi = P(\tilde{p}_N < 1)$ real depreciation		$\tilde{r}_D = r_D$	Deflation risk in the non tradable sector $\tilde{r}_{D^*} = r_{D^*}$

Table 2

where $\tilde{e}$ and $\tilde{\phi}_b$ are random variables indicating respectively the nominal exchange risk undergone, in case of devaluation, by the depositor who lends in domestic currency (the real exchange rate variation is thus offset by that of the nominal exchange rate) and the credit risk whenever the domestic bank become insolvent as a consequence of the nominal devaluation of the domestic currency.

<u>Result 3</u> *: Foreign lenders lend in foreign currency (D*) whenever the expected default risk of the debtor is lower than the expected exchange rate risk, following an adverse shock on the terms of trade.*

The above result implies that:

$$\pi \cdot r_{D^*}(1 - E(\phi_b(e))) \cdot \psi + \pi \cdot r_{D^*} \cdot (1-\psi) + (1-\pi) \cdot r_{D^*} > \pi \cdot \frac{r_D}{E(\tilde{e})} \cdot \psi +$$

$$\pi \cdot r_D \cdot (1-\psi) + (1-\pi) \cdot r_D \qquad (18)$$

and finally

$$1 - \phi_e(\varepsilon) > \frac{1}{e} \Leftrightarrow \phi_e(\varepsilon) < \frac{\Delta e}{e} \qquad (19)$$

In other words, foreign lenders choose D* whenever the default cost following a possible nominal devaluation is underestimated regarding to the perception of the exchange rate risk.

The maturity mismatch was often encouraged by domestic governments, especially during the Asian crisis, through implicit guarantees on foreign currency denominated liabilities, or through mechanisms[10] which facilitated foreign bank lending to domestic financial institutions or also through controls on the internal use of the domestic currency. Furthermore, the defence of fixed parity by the Government played an important part in the liability

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(so that p_N goes beyond unity which represents the equilibrium value of the real exchange rate) can be computed as follows:

$$\psi = 1 - \frac{\Lambda}{\xi \cdot (1-\chi) \cdot (a-1)} = 1 - \frac{0{,}55}{0{,}7 \cdot (1-0{,}5) \cdot (3-1)} = 0{,}21.$$

[10] As the Bangkok International Banking Facility (BIBF) in Thailand.

dollarization of balance sheets in emerging countries. This was usually achieved through sterilization of foreign capital inflows in order to control the monetary base and to prevent inflation and the real appreciation of the domestic currency. Sterilization is often difficult to achieve and, successful or not, it is likely to increase domestic interest rates and attract even more capital inflows.

5. The choice of maturity and currency composition of debt

The previous analysis put into light, on the one hand, that foreign currency denominated debt enable depositors to avoid exchange rate risk but, at the same time, expose them to the default risk of the banking sector and/or of the private sector, following an adverse shock.

On the other hand, according to the result of the third section, depositors could avoid credit risk (in connection with the contract renegotiation by the domestic bank) by means of demandable debt. The option of early withdrawal of demandable debt may partially or totally offset the default risk linked to the nominal devaluation.

The couples of maturity and currency as well as the underlying risks are summarized in table 3 below:

	D* (foreign currency loan)	D (domestic currency loan)
ST	-neither exchange rate risk nor credit risk linked to contract renegotiation; -default risk induced by the nominal devaluation (balance sheet effects) $\phi_b(\tilde{e})$.	- no credit risk linked to contract renegotiation; - exchange rate risk in case of nominal devaluation ($\tilde{e}$).
LT	- credit risk linked to contract renegotiation $(\tilde{\mu})$; - default risk induced by the nominal devaluation (balance sheet effects) $\phi_b(\tilde{e})$.	- credit risk linked to contract renegotiation; - exchange rate risk in case of nominal devaluation ($\tilde{e}$).

Table 3

Let us write the lenders payoffs in each specific case according to the underlying risks (table 4).

	D* (foreign currency loan)	D (domestic currency loan)
ST	$r_{D^*}(1-E(\phi_b'(\tilde{e})))$	$\frac{r_D}{E(\tilde{e})}$
LT	$r_{D^*}(1-\mathrm{E}(\phi_b(\tilde{e})))(1-\mu) = r(1-\mathrm{E}(\phi_b(\tilde{e})))$	$\frac{r_D}{E(\tilde{e})}(1-\mu) = \frac{r}{E(\tilde{e})}$

Table 4

where μ denotes the part of long term incomes of foreign lenders retained by the bank following the contract renegotiation at t = 1 and $(1-\phi_b'(\tilde{e}))$ denotes the default risk connected to the nominal devaluation. The default risk is partially or totally offset by the short maturity of the loan (where $\phi_b'(\tilde{e}) < \phi_b(\tilde{e})$ that is balance sheet effects affects more the senior debt that the junior one in case of nominal devaluation)

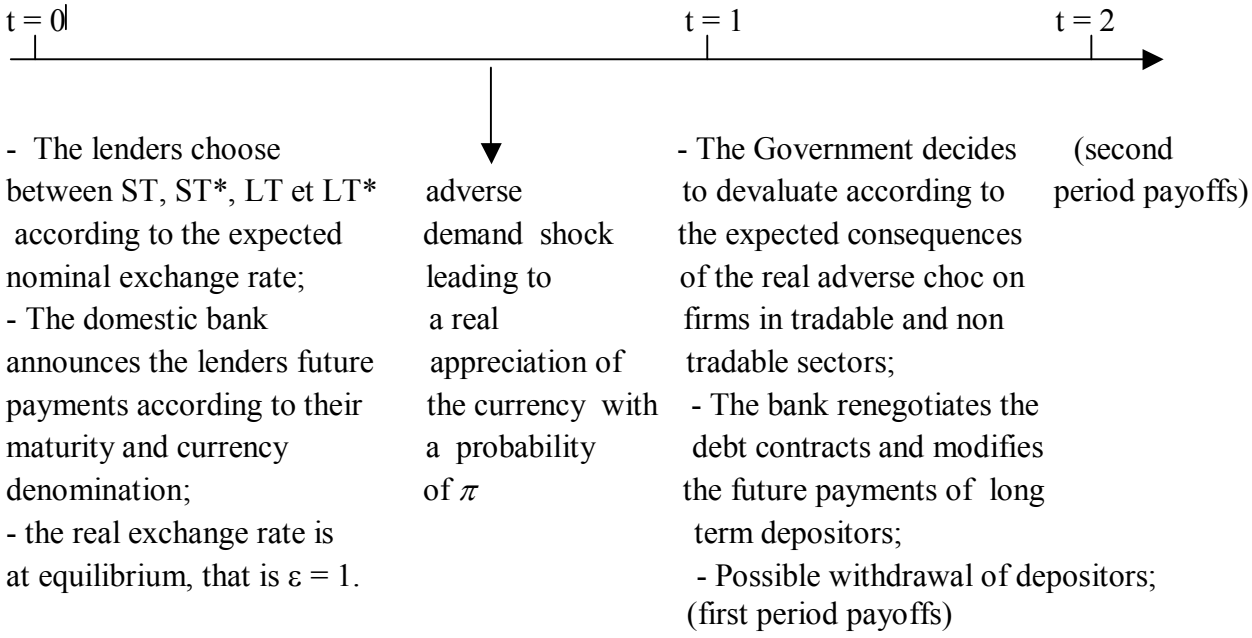
We look for the Nash equilibrium of the dynamic game involving the following players:

- the foreign lenders, who have two strategies available at t = 0 namely {short term

foreign currency denominated loan (ST*); short term domestic currency denominated loan (ST); long term foreign currency denominated loan (LT*); long term domestic currency denominated loan (ST)} and {withdraw; not withdraw} at t= 1;

- the domestic bank which announces, at t = 0, the depositors' future payments according to the maturity and the currency denomination of loans and has two strategies available at t = 1, namely {renegotiate debt contracts; respect debt contracts};
- the Government which has two strategies available at t = 1, following the adverse shock on the terms of trade, namely {devaluate the nominal exchange rate; defend the peg};
- the Nature, playing during the first period. As a consequence, the price of non tradable goods is beyond the equilibrium level (*1*) with a probability of π, which requires a nominal devaluation in order to re establish the equilibrium of the real exchange rate.

The order of the game decisions is illustrated below:



Let us reason by backward induction. Foreign depositors play last and choose to withdraw or not to withdraw the invested funds according to the expected payments at each period. Apart from the poor enforceability of contracts, they also take into account the default risk triggered by a nominal devaluation (in the case of foreign currency denominated debt) and alternatively, the exchange risk affecting the domestic currency denominated debt. Their withdrawal may be motivated either by the anticipation of a nominal devaluation or by the perspective of contract renegotiation by the bank.

In turn, the bank proposes, at t = 1, new cash flows to depositors willing to wait for two periods, according to their expected behaviour. As shown in the second section, in the case of demandable debt, the bank gives up contract renegotiation, whereas it alters the revenues of long term depositors (their income at the second period being fixed to *r*).

The government decides to devaluate the nominal exchange rate according to the expected consequences of his decision on the real economy and particularly on the competitiveness of the tradable sector. Devaluation occurs whenever the price of non tradable goods overpasses p_N^* (as computed in the previous section).

Finally, at t = 0, the foreign lenders choose the maturity as well as the currency composition of their loans to the domestic bank according to their anticipations of nominal devaluation and domestic bank behaviour at t = 1.

Suppose a representative lender who has to choose, at t = 0, among ST*, ST, LT* and LT. The project liquidation value is $R(1-\alpha)+r\alpha$. Should a nominal devaluation occurs (with a probability of ψ), the lender withdraws his money at t = 1. From the bank point of view, the due payment is *e,* in the case of ST* and 1, in the case of ST. The lender expected payoffs according to the probability of devaluation, the loan maturity and the currency composition are given in the table 5 below:

	D* (foreign currency loan)	D (domestic currency loan)
ST	$\psi \cdot \pi \cdot \frac{1}{e} \cdot Min\left(R(1-\alpha)+r\cdot\alpha; e\right)+$ $+(1-\psi\cdot\pi)\cdot 1$	$\Psi \cdot \pi \cdot \frac{1}{e}+(1-\Psi\cdot\pi)\cdot 1$
LT	$\Psi \cdot \pi \cdot \frac{r}{e}+(1-\Psi\cdot\pi)\cdot r$	$\Psi \cdot \pi \cdot \frac{r}{e}+(1-\Psi\cdot\pi)\cdot r$

Table 5

where π represents the objective probability of an adverse shock triggering a real appreciation of the domestic currency and ψ the probability of a nominal devaluation following the adverse shock.

For e >1 (that is nominal depreciation), short term foreign currency denominated debt dominates the other couples of maturity and currency as R (1- α) +rα >1 and r < 1.

It follows that, from the point of view of the foreign lender, it is optimal to choose the short term foreign currency denominated debt because, in this way, he offsets the default risk by the option of early withdrawal provided by the demandable debt.

Concluding remarks

In spite of the divergence of views on the origins and nature of international financial crises, there is yet an aggravating factor on which economists generally agree, namely the short term currency –denominated debt. This form of financing may lead to serious maturity and currency mismatches in bank balance sheets of emerging countries. Such unbalances create a sort of financial fragility of the domestic private sector and expose it to self-fulfilment confidence crises by foreign investors.

The present paper could be embedded in the recent analytical literature founded on endogenous currency composition and financial structure of liabilities (Aghion, Bacchetta and Banerjee (2001), Caballero and Krishnamurthy (2000, 2001 b), Calvo (1998), Diamond and Rajan (2000, 01), Jeanne (1999 (a,b),2000), Schneider and Tornell (1999), Schneider and Westermann (2002)). These authors aim at explaining why short term foreign denominated debt is chosen at the equilibrium of the credit market game.

Regarding the maturity mismatch, we showed that there was a major difference between a bank bargaining with creditors having ordinary debt and a bank bargaining with the demand depositors. Whenever the bank attempts to renegotiate the contract at an intermediary stage or take any other decision against the demand depositors' interests, demand depositors may trigger a bank run which puts the banks outside the intermediation relationship and drives its rents to zero. This threat disciplines the financial intermediary and serves as a commitment device in order to protect investors' interest.

As for the currency mismatch, it results from the choice of foreign lenders whose anticipations of exchange rate risk overpass those of default of the banking and/or private sector following a real adverse shock.

Short term foreign currency denominated debt allows investors to offset the credit risk by the option of withdraw at any moment and prior to other lenders, option offered by the short maturity of their claims.

The conjunction of these two mismatches in a context of financial liberalization and poor regulation may lead to a cumulative endogenous process of real appreciation, indebtedness and investment in the emerging country. Whenever an adverse real shock occurs, the same cumulative process takes place in the opposite way until the Government decides to put an end to deflation and let the currency float. Domestic balance sheets serve as propagation mechanism, in presence of liability dollarization, of the recessionary effects of the nominal depreciation on the emerging economy.

The market failure could be avoided if Government could credibly commit itself towards the foreign lenders and conclude a contract with them in a coordinate way. As suggested by Tirole (2002), an international institution could play the role of a delegated monitor at the international level in order to offset the lacking contract between the domestic Government and foreign lenders. In this way, emerging countries could better benefit from their financial liberalization.

The intervention of this supplementary actor as well as the opportunity of different measures proposed in the context of the debate on the international financial architecture (capital controls, international lender of last resort, etc) are subject of our future research.

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